

Comments on the March 4th 2016 meeting with BioPath on implementation of bioremediation at the Allied Paper Landfill, Kalamazoo, Michigan

FIELDS Group (Region 5, Superfund)
Engineering Technical Support Center (ORD Cincinnati, Ohio)

General Comments

At the request of Kalamazoo Mayor Hopewell, USEPA hosted BioPath Solutions (BioPath) at Region 5 offices on March 4, 2016. In attendance were representatives, of the City of Kalamazoo, including Mayor Hopewell, EPAUSEPA Region 5 Superfund staff and management, including the Superfund Division Director and representatives of EPAUSEPA's Engineering Technical Support Center. (for EPA's Office of Research and Development). The intent of the meeting, communicated by EPAUSEPA to BioPath was for BioPath BioPath to explain the means by which the technology breaks down PCBs and their plans for a bench-scale study to demonstrate their technology. Prior to the meeting, EPAUSEPA requested that BioPath accomplish the following at the meeting:

1. Discuss their technology and previous work.
2. Explain how their methods in previous studies line up with the guidances and information previously provided by EPAUSEPA (see attached).
3. Specifically discuss their study design and results for their recent tests of their technology on residuals collected from the Kalamazoo River.
4. Discuss the specific mechanisms in your treatment technology.
5. Describe in detail the end products of their treatment technology.

The focus of the BioPath team presentation was a proposal for an in-field pilot test at Allied Landfill to demonstrate the ability of the Biopath technology to biodegrade the landfill paper pulp and PCBs. USEPAUSEPA personnel noted that the presentation was inconsistent with the planned purpose of the meeting. was for BioPath's to explain explanation of the means by which the BioPaththeir technology breaks down PCBs and their plans for a demonstration of their technology through a bench-scale study to demonstrate their technology.

The During the course of the meeting, BioPath team did not was not able to explain the means by which its technology breaks down PCBs nor did it provide a plan for a bench-scale study. There was, however, recognition on the part of the BioPath team. The BioPath did recognize that that they would need to conduct a bench-scale study, with methods that following the EPAUSEPA model Quality Assurance Project Plan APP(QAPP) and EPAUSEPA relevant guidance, and be prepared to discuss its results in detail. This bench-scale study would be required if Region 5 USEPAUSEPA were to consider the PCB bioremediation methods proposed by BioPath for the Allied Landfill Superfund site.

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Issues Regarding the Biopath Pilot Proposal

The Biopath in-field pilot test generally consisted of treating the waste in large open piles on Allied Landfill. Experimental design – The experimental design presented by Biopath was problematic as several important pieces were either lacking or poorly explained. For example, the design discussed at the meeting listed two control piles and five treatment piles but did not specify their construction or composition of the treatment piles. It appears Biopath is planning to duplicate one of the five treatments in a second pile as a control. It is likely this level of replication is too small to demonstrate performance.

Sampling Plan - The sampling plan to assess the chemical composition of the degradation process over time is also lacking. For example, it is not clear which samples would have matrix spikes to demonstrate the ability to quantify compounds of interest in the actual matrices. Additionally, we observed that Biopath did not:

Commented [BM1]: Use of matrix spikes is important because...

- 1) display an understanding of the PCB degradation patterns relevant to their technology and this site. Thus, Biopath did not understand which breakdown components compounds to track so as to document treatment.
- 2) have a clear understanding of what measurement techniques to use.
- 3) demonstrate an understanding of the need to monitor for intermediates and final degradation products.

Composting – Biopath proposes that they can treat the waste by composting it in large piles. Biopath claimed that the smallest pile possible to demonstrate treatment would be 30 ft in diameter by 10 ft tall. We do not understand the reasoning behind this claim (there may be one, but it was not explained) since many smaller scale systems are available for backyard activities and have been successfully used in research.

Conservation of Mass- The experimental design of Biopath's pilot study did not include methods for determining whether there was conservation of mass during the study. If materials are gained or lost in the process, it can be difficult to determine if decreases in PCB concentration are actually due to treatment. As explained by the vendor, their Biopath's remediation technique also adds would include the addition of a substantial material volume of material in their composting process – this could result in dilution of the existing contaminated landfill material, and would result in increasing the volume of contaminated material (and therefore the size of the landfill). In addition, it is not clear how Biopath Composting materials in large open piles will not maintain control over gaseous emissions, which may include volatilized PCBs from these large piles. As a result, for these reasons, it seems unlikely that Biopath will be able to differentiate treatment from dilution and/or contaminant volatilization were post treatment sampling results to show lower concentrations of PCBs with these large piles. Without controlling for mass, it would be impossible to know if treatment through destruction of PCBs is occurring. Based on the limited information Biopath has supplied about their technology,

volatilization and dilution appear to be significant factors in the technology. - Their treatment demonstration needs to measure the contributions of volatilization and dilution to contaminant removal. Additionally, the addition of material and mixture with contaminated waste would also result in increasing the volume of contaminated material (and therefore the size of the landfill). - As explained by the vendor, their remediation technique also adds substantial material volume in their process - this could result in dilution of the existing contaminated landfill material, and would result in increasing the volume of contaminated material (and therefore the size of the landfill).

Paper Pulp – BioPath also claimed that they would reduce the paper pulp mass by through the composting and breakdown of the material. -They plan to aerate compost piles to accomplish this reduction. Since the paper pulp is fine grained, cohesive, and mixed with clay/fine silt material it would likely be very difficult to aerate the piles without first adding a bulking agent to facilitate air movement in the pile. - The additional volume of the bulking agent may neutralize expected reductions in pulp mass. At best, small scale testing will be needed to determine the possible benefit of composting.

Pathogens – It is common for bioaugmentation cultures to demonstrate that they do not contain pathogens. It would be helpful to know if BioPath has characterized the composition of their amendments they use for remediation, and can rule out that concern.

Issues Regarding a Biopath Bench-scale Study

In the event that Biopath pursues the USEPA-recommended bench scale study and would like to continue the dialogue with Region 5, ~~the following questions EPA still has issues with their study design and outstanding questions that Biopath would need to be addressed~~ address:

- BioPath will need to address the following topics regarding the bench-study sample design and quality control: degradation pathway; study objectives; experimental controls; treatment replicates; treatment monitoring plan including chemicals measured (intermediates and degradation products should be included) and sampling schedule; description of treatment units and operation; and measuring contaminant loss due to volatilization and dilution.
- What are the organisms and metabolic pathways being used in the BioPath process? Specifically, BioPath need to provide details of the aerobic and anaerobic pathways being used and the chemical intermediates expected as the treatment proceeds. -BioPath should also provide a reasonable listing of organisms that are, or could be, stimulated by their BioBlend Process. It is difficult for the agency scientists to understand the method of dechlorination and degradation without knowing the organisms involved in the process.

- Aerobic reduction – BioPath mentioned aerobic reductive dechlorination as a, or the, method of PCB degradation. Biopath will need to expand on this explanation and elaborate on how this process can completely degrade PCB molecules. The agency scientists do not know of an aerobic pathway ~~to~~ for dechlorination ~~for~~ of highly chlorinated PCB molecules (more than 4 chlorines); this generally requires anaerobic dechlorination. Additionally, dechlorination does not address the degradation of biphenyls to chlorobenzoates and beyond. It would be helpful if the vendor could provide some references which discuss this biological pathway. BioPath will need to ~~address~~ account for all of the degradation pathways in a bench study.
- BioPath explained that “The Factor” was a protein that decreased the inhibition of enzymatic activity caused by chlorinated compounds, which relieved inhibition caused by chlorinated molecules. This claim would benefit from additional explanation. For example, how do chlorinated chemicals inhibit the indigenous microbes? Which pathways are inhibited? How does the protein remove the inhibition? Have other scientists ~~o~~ observed this situation?
- What are the chemical pathways (stoichiometry) of the breakdown of PCBs? BioPath needs to address the fate of all PCB congeners.
- What are the intermediate and final molecules? Include transitory, ‘dead-end’, and desired molecular results.
- What if any changes in toxicity occurred as a result of the process? The toxicity of the intermediate and final molecules expected in the degradation process would be helpful.
- Patent – BioPath stated that a patent was pending for the BioBlend Process. Presumably this claim means that they have filed a patent with the US Patent and Trademark Office. If so, the patent submission should be available about one year ~~1-yr~~ after filing. It would be helpful to know when BioPath filed for the patent. Perhaps they would be willing to share their patent submission since the information may explain their process more completely.